Claims

What is claimed is:

1. A body fluid shunt comprising:
   a. an inlet port;
   b. an outlet port;
   c. a fluid passage between the inlet and outlet ports;
   d. a valve situated between the inlet and outlet ports, the valve defining:
      (1) an upstream side of the fluid passage between the inlet port and the valve, and
      (2) a downstream side of the fluid passage between the valve and the outlet port;
   e. a piston:
      (1) having a piston face defined on the upstream side of the fluid passage, and
      (2) being displaceable to actuate the valve,

   wherein fluid bearing on the piston face at or above a shunting pressure will displace the piston to actuate the valve, and thereby allow passage of fluid between the inlet and outlet ports.

2. The body fluid shunt of claim 1 wherein at least a portion of the piston face is defined by a deformable diaphragm.

3. The body fluid shunt of claim 2 wherein the deformable diaphragm has opposing sides defining:

   a. a fluid side, the fluid side being at least partially bounded by the upstream side of the fluid passage, and

   b. a gas side, the gas side being at least partially bounded by a gas chamber, the gas chamber being closed to the ingress of fluid.

4. The body fluid shunt of claim 3 wherein the gas chamber has selectively adjustable volume, whereby a user may selectively adjust the gas chamber volume to adjust the pressure of gas therein, and thereby adjust the gas pressure on the gas side of the deformable diaphragm.

5. The body fluid shunt of claim 1 wherein:

   a. the piston is displaceable along a piston travel axis; and

   b. fluid flowing through the valve between the upstream and downstream sides of the flow passage flows along a valve flow direction oriented at least substantially perpendicular to the piston travel axis.

6. The body fluid shunt of claim 1 wherein the piston includes:

   a. a piston tail end opposite its piston face, and

   b. an intermediate length extending between its face and piston tail end,

and wherein the downstream side of the fluid passage opens onto the piston only at the intermediate length of the piston.

7. The body fluid shunt of claim 1 wherein the valve is at least partially defined by:

a. a drain port extending between the upstream and downstream sides of the fluid passage, and

b. a cutout defined in the piston, the cutout being alignable with the drain port when the piston is displaced,

wherein alignment of the cutout and the drain port opens the valve.

8. The body fluid shunt of claim 1 wherein the valve is at least partially defined by:

a. a drain port extending between the upstream and downstream sides of the fluid passage, and

b. a mask affixed to the piston, the mask having a cutout defined therein,

wherein the valve has:

(1) a closed state wherein the mask covers the drain port;

(2) an open state wherein the piston is displaced to move the cutout of the mask into alignment with the drain port.

9. The body fluid shunt of claim 8 wherein the mask is made of deformable material, whereby the mask bears against the drain port in accordance with any pressure differential between the upstream and downstream sides of the fluid passage.

10. The body fluid shunt of claim 9 wherein the mask is a flexible membrane.

11. The body fluid shunt of claim 1 wherein the piston has a piston tail end opposite its piston face, and wherein the upstream side of the fluid passage opens onto the piston tail end.

12. The body fluid shunt of claim 1 wherein the deformable diaphragm includes:
    a. a fluid side, the fluid side being at least partially bounded by the upstream side of the fluid passage, and
    b. an opposite side isolated from the upstream side of the fluid passage.

13. The body fluid shunt of claim 12 wherein the opposite side is biased by at least one of:
    a. a compressible gas chamber; and
    b. a spring.

14. The body fluid shunt of claim 12 wherein the opposite site is also isolated from the downstream side of the fluid passage.

15. The body fluid shunt of claim 14 wherein the pressure on the opposite side is adjustable to a fixed level.

16. The body fluid shunt of claim 15 wherein the opposite side is bounded by a gas chamber having selectively adjustable volume, whereby a user may selectively adjust the gas chamber volume to adjust the pressure of gas therein, and thereby adjust the gas pressure on the opposite side of the diaphragm.

17. The body fluid shunt of claim 1 wherein the position of the piston is independent of the pressure in the downstream side of the fluid passage.

18. The body fluid shunt of claim 1 wherein the inlet port is in fluid communication with a brain.

19. The body fluid shunt of claim 1 wherein the outlet port has an elongated flexible catheter extending therefrom.

20. The body fluid shunt of claim 1 wherein:
    a. the inlet port is in fluid communication with a first cavity in a human body, and
    b. the outlet port is in fluid communication with a second cavity in the body.

21. The body fluid shunt of claim 20 wherein the first and second cavities are at different elevations in the body when the body is standing erect.

22. A body fluid shunt comprising:

a. an inlet port;

b. an outlet port;

c. a fluid passage between the inlet and outlet ports;

d. a valve situated between the inlet and outlet ports, the valve defining:

(1) an upstream side of the fluid passage between the inlet port and the valve, and

(2) a downstream side of the fluid passage between the valve and the outlet port;

e. a movable valve actuating member adjacent the upstream side of the fluid passage and isolated from the downstream side of the fluid passage, wherein the valve actuating member:

(1) is biased by a biasing force to maintain the valve in a normally closed state, and

(2) moves in response to a pressure differential between the fluid pressure in the upstream side of the fluid passage and the pressure exerted by the biasing force,

whereby the pressure differential will move the valve actuating member and open the valve upon attaining a threshold magnitude.

23. The body fluid shunt of claim 22 wherein the diaphragm is isolated from the downstream side of the fluid passage.

24. The body fluid shunt of claim 22 wherein the opening of the valve is independent of the pressure in the downstream side of the fluid passage.

25. The body fluid shunt of claim 22 wherein:

a. the valve actuating member is a piston; and

b. the biasing force is provided by one or more of:

(1) an elastic diaphragm;

(2) a compressible gas chamber; and

(3) a spring.

26. The body fluid shunt of claim 22 wherein the valve is defined as a cutout within the piston, whereby the valve is opened when the cutout moves into alignment with the fluid passage.

27. The body fluid shunt of claim 22 wherein:

a. the diaphragm includes a first side and an opposing second side,

b. the first side is exposed to the upstream side of the fluid passage, and

c. the second side is isolated from the upstream side of the fluid passage, and has an external biasing force acting thereon.

28. The body fluid shunt of claim 27 wherein the second side is also isolated from the downstream side of the fluid passage.

29. The body fluid shunt of claim 27 wherein the external biasing force acting on the second side is provided by at least one of:

a. a spring, and

b. a compressible gas chamber.

30. The body fluid shunt of claim 22 further comprising a piston extending from the diaphragm, wherein:

a. deformation of the diaphragm moves the piston along a travel axis; and

b. the valve is provided on the piston.

31. The body fluid shunt of claim 30 wherein the valve is at least partially defined by a cutout defined in the piston, and wherein the piston is movable to align the cutout to open simultaneously onto both the upstream and downstream sides of the fluid passage, thereby opening the valve.

32. The body fluid shunt of claim 30 wherein the valve is at least partially defined by a mask affixed to the piston, the mask having a cutout defined therein, wherein the valve has:

(1) a closed state wherein the mask is situated between the upstream and downstream sides of the fluid passage;

(2) an open state wherein the piston is displaced to move the cutout of the mask into alignment with both the upstream and downstream sides of the fluid passage.

33. The body fluid shunt of claim 30 wherein fluid flowing through the valve between the upstream and downstream sides of the flow passage flows along a valve flow direction oriented at least substantially perpendicular to the travel axis.

34. The body fluid shunt of claim 22 wherein:

a. the inlet port is in fluid communication with a first cavity in a human body, and

b. the outlet port is in fluid communication with a second cavity in the body.

35. The body fluid shunt of claim 34 wherein the first and second cavities are at different elevations in the body when the body is standing erect.

36. The body fluid shunt of claim 22 wherein the inlet port is in fluid communication with a brain.

37. The body fluid shunt of claim 22 wherein the outlet port has an elongated flexible catheter extending therefrom.

38. A body fluid shunt comprising:

a. an inlet port;

b. an outlet port;

c. a fluid passage between the inlet and outlet ports;

d. a valve situated in the fluid passage, the valve defining:

(1) an upstream side of the fluid passage between the inlet port and the valve, and

(2) a downstream side of the fluid passage between the valve and the outlet port;

e. a deformable diaphragm exposed to the upstream side of the fluid passage, the diaphragm being connected to the valve, wherein fluid bearing on the diaphragm at or above a shunting pressure will deform the diaphragm to actuate the valve, thereby allowing passage of fluid between the inlet and outlet ports.

39. The body fluid shunt of claim 38 wherein the diaphragm is not exposed to the downstream side of the fluid passage.

40. The body fluid shunt of claim 38 wherein:
    a. the valve opening member is a piston; and
    b. the biasing force is provided by one or more of:
        (1) an elastic diaphragm;
        (2) a compressible gas chamber; and
        (3) a spring.

41. The body fluid shunt of claim 38 wherein the valve is defined as a cutout within the piston, whereby the valve is opened when the cutout moves into alignment with the fluid passage.

42. The body fluid shunt of claim 38 wherein the biasing force is at least partially provided by a deformable diaphragm coupled to the valve opening member, the deformable diaphragm including:
    a. a fluid side which is at least partially bounded by the upstream side of the fluid passage, and
    b. an opposite side isolated from the upstream side of the fluid passage.

43. The body fluid shunt of claim 42 wherein the opposite side is biased by at least one of:
    a. a compressible gas chamber; and
    b. a spring.

44. The body fluid shunt of claim 42 wherein the opposite site is also isolated from the downstream side of the fluid passage.

45. The body fluid shunt of claim 44 wherein the pressure on the opposite side is adjustable to a fixed level.

46. The body fluid shunt of claim 42 wherein the opposite side is bounded by a gas chamber.

47. The body fluid shunt of claim 46 wherein the gas chamber has selectively adjustable volume, whereby a user may selectively adjust the gas chamber volume to adjust the pressure of gas therein, and thereby adjust the gas pressure on the opposite side of the diaphragm.

48. The body fluid shunt of claim 38 wherein the biasing force is at least partially provided by a deformable diaphragm coupled to the valve opening member, the deformable diaphragm having opposing sides defining:

a. a fluid side, the fluid side being at least partially bounded by the upstream side of the fluid passage, and

b. a gas side, the gas side being at least partially bounded by a gas chamber, the gas chamber being closed to the ingress of fluid from the fluid passage.

49. The body fluid shunt of claim 48 wherein the gas chamber has selectively adjustable volume, whereby a user may selectively adjust the gas chamber volume to adjust the pressure of gas therein, and thereby adjust the gas pressure on the gas side of the deformable diaphragm.

50. The body fluid shunt of claim 38 wherein:

a. the valve opening member is confined to move along a travel axis; and

b. fluid flowing through the valve between the upstream and downstream sides of the flow passage flows along a valve flow direction oriented at least substantially perpendicular to the travel axis.

51. The body fluid shunt of claim 38 wherein:

a. the valve opening member is confined to move along a travel axis, and has opposing ends situated along the travel axis with an intermediate length extending therebetween; and

b. the valve is located along the intermediate length of the valve opening member.

52. The body fluid shunt of claim 38 wherein the valve is at least partially defined by:

a. a drain port extending between the upstream and downstream sides of the fluid passage, and

b. a cutout defined in the piston, the cutout being alignable with the drain port when the piston is displaced,

wherein alignment of the cutout and the drain port opens the valve.

53. The body fluid shunt of claim 38 wherein the valve is at least partially defined by:

a. a drain port extending between the upstream and downstream sides of the fluid passage, and

b. a mask affixed to the piston, the mask having a cutout defined therein, wherein the valve has:

(1) a closed state wherein the mask covers the drain port;

(2) an open state wherein the piston is displaced to move the cutout of the mask into alignment with the drain port.

54. The body fluid shunt of claim 53 wherein the mask is made of deformable material, whereby the mask bears against the drain port in accordance with any pressure differential between the upstream and downstream sides of the fluid passage.

55. The body fluid shunt of claim 38 wherein:

a. the inlet port is in fluid communication with a first cavity in a human body, and

b. the outlet port is in fluid communication with a second cavity in the body.

56. The body fluid shunt of claim 38 wherein the inlet port is in fluid communication with a brain.

57. The body fluid shunt of claim 38 wherein the outlet port has an elongated flexible catheter extending therefrom.

58. A body fluid shunt comprising:

a. an inlet port;

b. an outlet port;

c. a fluid passage between the inlet and outlet ports, the fluid passage having an upstream side leading from the inlet port and a downstream side leading to the outlet port;

d. a deformable diaphragm having a first face adjacent the upstream side and an opposing second face, whereby fluid pressure in the upstream side acts on the first face;

e. a piston coupled to the diaphragm wherein:

(1) the diaphragm, when undeformed, locates the piston to block fluid flow between the upstream and downstream sides;

(2) deformation of the diaphragm locates the piston to allow fluid flow between the upstream and downstream sides.

59. The body fluid shunt of claim 58 wherein the location of the piston is independent of the pressure in the downstream side of the fluid passage.

60. The body fluid shunt of claim 58 wherein the second face of the diaphragm is isolated from the upstream and downstream sides of the fluid passage, whereby fluid pressure in the upstream and downstream sides does not act on the second face.

61. The body fluid shunt of claim 58 wherein the second face of the diaphragm is at least partially bounded by a gas chamber, the gas chamber being closed to the ingress of fluid from the fluid passage.

62. The body fluid shunt of claim 58 wherein the second face of the diaphragm is biased by at least one of:

a. a compressible gas chamber; and

b. a spring.

63. The body fluid shunt of claim 58 wherein the second face of the diaphragm is bounded by a gas chamber having selectively adjustable volume, whereby a user may selectively adjust the gas chamber volume to adjust the pressure of gas therein, and thereby adjust the gas pressure on the second face of the diaphragm.

64. The body fluid shunt of claim 58 wherein:

a. the piston is relocated along a piston travel axis during deformation of the diaphragm; and

b. fluid flowing between the upstream and downstream sides of the flow passage flows along a valve flow direction oriented at least substantially perpendicular to the piston travel axis.

65. The body fluid shunt of claim 58 wherein the piston includes a cutout defined therein, the cutout being alignable between the upstream and downstream sides during relocation of the piston to allow fluid flow between the upstream and downstream sides, and the piston otherwise blocking fluid flow between the upstream and downstream sides when the cutout is not aligned therebetween.

66. The body fluid shunt of claim 65 wherein the piston includes a mask attached thereon, and wherein the mask has the cutout defined therein.

67. The body fluid shunt of claim 66 wherein the mask is a flexible membrane.

68. The body fluid shunt of claim 58 wherein:

a. the inlet port is in fluid communication with a first cavity in a human body, and

b. the outlet port is in fluid communication with a second cavity in the body.

69. The body fluid shunt of claim 68 wherein the first and second cavities are at different elevations in the body when the body is standing erect.

70. The body fluid shunt of claim 58 wherein the inlet port is in fluid communication with a brain.

71. The body fluid shunt of claim 58 wherein the outlet port has an elongated flexible catheter extending therefrom.